CLAIM AMENDMENTS

1   1.   (Currently amended) A method of determining a placement of services of a

2   distributed application onto nodes of a distributed resource infrastructure

3   comprising the steps of:

4   a.   forming communication constraints between node pairs which ensure that

5   a sum of transport demands between a particular node pair does not exceed a

6   transport capacity between the particular node pair, each term of the sum

7   comprising a product of a first placement variable, a second placement

8   variable, and the transport demand between the services associated with the

9   first and second placement variables;

10   b.   forming an objective; and

11   c.   employing a local search solution to solve an integer program comprising

12   the communication constraints and the objective, which determines the

13   placement of the services onto the nodes.

1   2.   (Currently amended) A method of determining a placement of services of a

2   distributed application onto nodes of a distributed resource infrastructure

3   comprising the steps of:

4   a.   establishing an application model of the services comprising transport

5   demands between the services;

6   b.   establishing an infrastructure model of the nodes comprising transport

7   capacities between the nodes;

8   c.   forming an integer program that comprises:

9   i.   a set of placement variables for a combination of the services and the

10   nodes, each of the placement variables indicating whether a particular

11   service is located on a particular node;

12   ii.   communication constraints between node pairs which ensure that a

13   sum of the transport demands between a particular node pair does not

14   exceed the transport capacity between the particular node pair, each term

15   of the sum comprising a product of a first placement variable, a second

16   placement variable, and the transport demand between the services

17   associated with the first and second placement variables; and

18   iii.   an objective; and

19   ~~d.~~   employing a local search solution to solve the integer program which

20   determines the placement of the services onto the nodes.

1   3.   (Original)   The method of claim 2 wherein the step of solving the integer

2   program employs a local search solution.

1   4.   (Original)   The method of claim 2 wherein the objective comprises

2   minimizing communication traffic between the nodes.

1   5.   (Original)   The method of claim 2 wherein the application model further

2   comprises processing demands for the services.

1   6.   (Original)   The method of claim 5 wherein the infrastructure model further

2   comprises processing capacities for the nodes.

1   7.   (Original)   The method of claim 6 wherein the integer program further

2   comprises processing constraints which ensure that a sum of the processing

3   demands for each of the nodes does not exceed the processing capacity for the

4   node.

1   8.   (Original)   The method of claim 7 wherein the objective comprises

2   minimizing communication traffic between the nodes and balancing the

3   processing demands on the nodes.

1   9.   (Original)   The method of claim 6 wherein the processing demands and the

2   processing capacities are normalized according to a processing criterion.

1   10.   (Original)   The method of claim 9 wherein the processing criterion

2   comprises an algorithm speed.

1   11.   (Original)   The method of claim 9 wherein the processing criterion

2   comprises a transaction speed.

1   12.   (Original)   The method of claim 9 wherein the processing capacities of the

2   nodes are found according to a look-up table in which different types of nodes

3   have been normalized according to the processing criterion.

1   13.   (Original)   The method of claim 2 wherein the application model further

2   comprises storage demands for the services.

1   14.   (Original)   The method of claim 13 wherein the infrastructure model

2   further comprises storage capacities for the nodes.

1   15.   (Original)   The method of claim 14 wherein the integer program further

2   comprises storage constraints which ensure that a sum of the storage demands for

3   each of the nodes does not exceed the storage capacity for the node.

1   16.   (Original)   The method of claim 2 wherein the integer program further

2   comprises placement constraints which ensure that each of the services is placed

3   on one and only one of the nodes.

1   17.   (Original)   The method of claim 2 wherein the services reside on the nodes

2   according to a previous assignment.

1   18.   (Original)   The method of claim 17 further comprising the step of

2   assessing reassignment penalties for service placements that differs from the

3   previous assignment.

1   19.   (Original)   The method of claim 18 wherein the integer program further

2   comprises a second objective that seeks to minimize the reassignment penalties.

1   20.   (Currently amended) A method of determining a placement of services of a

2   distributed application onto nodes of a distributed resource infrastructure

3   comprising the steps of:

4   a.   establishing an application model of the services that comprises processing

5   demands for the services, storage demands for the services, and transport

6   demands between the services;

7   b.   establishing an infrastructure model of the nodes that comprises processing

8   capacities for the nodes, storage capacities for the nodes, and transport

9   capacities between the nodes;

10   c.   forming an integer program that comprises:

11   i.   a set of placement variables for a combination of the services and the

12   nodes, each of the placement variables indicating whether a particular

13   service is located on a particular node;

14   ii.   processing constraints which ensure that a sum of the processing

15   demands for each of the nodes does not exceed the processing capacity for

16   the node;

17   iii.   storage constraints which ensure that a sum of the storage demands for

18   each of the nodes does not exceed the storage capacity for the node;

19   iv.   placement constraints which ensure that each of the services is placed

20   on one and only one node;

21   v.   communication constraints between node pairs which ensure that a

22   sum of the transport demands between a particular node pair does not

23   exceed the transport capacity between the particular node pair, each term

24   of the sum comprising a product of a first placement variable, a second

25   placement variable, and the transport demand between the services

26   associated with the first and second placement variables; and

27   vi.   an objective of minimizing communication traffic between the nodes

28   and balancing processing loads on the nodes; and

29   d.   employing a local search solution to solve the integer program which

30   determines the placement of the services onto the nodes.

1   21.   (Currently amended) A computer readable memory comprising computer

2   code for directing a computer to make a determination of a placement of services

3   of a distributed application onto nodes of a distributed resource infrastructure, the

4   determination of the placement of the services onto the nodes comprising the steps

5   of:

6   a.   forming communication constraints between node pairs which ensure that

7   a sum of transport demands between a particular node pair does not exceed a

8   transport capacity between the particular node pair, each term of the sum

9   comprising a product of a first placement variable, a second placement

10   variable, and the transport demand between the services associated with the

11   first and second placement variables;

12   b. forming an objective; and

13   c. employing a local search solution to solve an integer program comprising

14   the communication constraints and the objective, which determines the

15   placement of the services onto the nodes.

1   22.   (Currently amended) A computer readable memory comprising computer

2   code for directing a computer to make a determination of a placement of services

3   of a distributed application onto nodes of a distributed resource infrastructure, the

4   determination of the placement of the services onto the nodes comprising the steps

5   of:

6   a. establishing an application model of the services comprising transport

7   demands between the services;

8   b. establishing an infrastructure model of the nodes comprising transport

9   capacities between the nodes;

10   c. forming an integer program that comprises:

11   i. a set of placement variables for a combination of the services and the

12   nodes, each of the placement variables indicating whether a particular

13   service is located on a particular node;

14   ii. communication constraints between node pairs which ensure that a

15   sum of the transport demands between a particular node pair does not

16   exceed the transport capacity between the particular node pair, each term

17   of the sum comprising a product of a first placement variable, a second

18   placement variable, and the transport demand between the services

19   associated with the first and second placement variables; and

20   iii. an objective; and

21   d. employing a local search solution to solve the integer program which

22   determines the placement of the services onto the nodes.

1   23.   (Original)   The computer readable memory of claim 22 wherein the step of

2   solving the integer program employs a local search solution.

1   24.   (Original)   The computer readable memory of claim 22 wherein the

2   objective comprises minimizing communication traffic between the nodes.

1 25. (Original) The computer readable memory of claim 22 wherein the
2   application model further comprises processing demands for the services.

1 26. (Original) The computer readable memory of claim 25 wherein the
2   infrastructure model further comprises processing capacities for the nodes.

1 27. (Original) The computer readable memory of claim 26 wherein the integer
2   program further comprises processing constraints ensure that a sum of the
3   processing demands for each of the nodes does not exceed the processing capacity
4   for the node.

1 28. (Original) The computer readable memory of claim 27 wherein the
2   objective comprises balancing the processing demands on the nodes.

1 29. (Original) The computer readable memory of claim 26 wherein the
2   processing demands and the processing capacities are normalized according to a
3   processing criterion.

1 30. (Original) The computer readable memory of claim 29 wherein the
2   processing criterion comprises an algorithm speed.

1 31. (Original) The computer readable memory of claim 9 wherein the
2   processing criterion comprises a transaction speed.

1 32. (Original) The computer readable memory of claim 9 wherein the
2   processing capacities of the nodes are found according to a look-up table in which
3   different types of nodes have been normalized according to the processing
4   criterion.

1 33. (Original) The computer readable memory of claim 22 wherein the
2   application model further comprises storage demands for the services.

1 34. (Original) The computer readable memory of claim 33 wherein the

2   infrastructure model further comprises storage capacities for the nodes.

1   35.   (Original)   The computer readable memory of claim 34 wherein the integer

2   program further comprises storage constraints which ensure that a sum of the

3   storage demands for each of the nodes does not exceed the storage capacity for the

4   node.

1   36.   (Original)   The computer readable memory of claim 22 wherein the integer

2   program further comprises placement constraints which ensure that each of the

3   services is placed on one and only one of the nodes.

1   37.   (Original)   The computer readable memory of claim 22 wherein the

2   services reside on the nodes according to a previous assignment.

1   38.   (Original)   The computer readable memory of claim 37 further comprising

2   the step of assessing reassignment penalties for service placements that differs

3   from the previous assignment.

1   39.   (Original)   The computer readable memory of claim 38 wherein the integer

2   program further comprises a second objective that seeks to minimize the

3   reassignment penalties.

1   40.   (Currently amended)   A computer readable memory comprising computer

2   code for directing a computer to make a determination of a placement of services

3   of a distributed application onto nodes of a distributed resource infrastructure, the

4   determination of the placement of the services onto the nodes comprising the steps

5   of:

6   a.   establishing an application model of the services that comprises

7   processing demands for the services, storage demands for the services, and

8   transport demands between the services;

9   b.   establishing an infrastructure model of the nodes that comprises processing

10   capacities for the nodes, storage capacities for the nodes, and transport

11   capacities between the nodes;

12   c.   forming an integer program that comprises:

13   i.   a set of placement variables for a combination of the services and the
14   nodes, each of the placement variables indicating whether a particular
15   service is located on a particular node;

16   ii.   processing constraints which ensure that a sum of the processing
17   demands for each of the nodes does not exceed the processing capacity for
18   the node;

19   iii.   storage constraints which ensure that a sum of the storage demands for
20   each of the nodes does not exceed the storage capacity for the node;

21   iv.   placement constraints which ensure that each of the services is placed
22   on one and only one node;

23   v.   communication constraints between node pairs which ensure that a
24   sum of the transport demands between a particular node pair does not
25   exceed the transport capacity between the particular node pair, each term
26   of the sum comprising a product of a first placement variable, a second
27   placement variable, and the transport demand between the services
28   associated with the first and second placement variables; and

29   vi.   an objective of minimizing communication traffic between the nodes
30   and balancing processing loads on the nodes; and

31 d.   employing a local search solution to solve the integer program which
32   determines the placement of the services onto the nodes.